



United States  
General Accounting Office  
Washington, D.C. 20548

Resources, Community, and  
Economic Development Division

B-271613

April 10, 1996

The Honorable Ron Wyden  
United States Senate

Dear Senator Wyden:

You requested that we review actions taken by the Department of Energy (DOE) to comply with the Wyden amendment of the National Defense Authorization Act for Fiscal Year 1991 (section 3137 of Public Law 101-510). This section of the law, entitled "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," addresses the safety of the 177 underground tanks at DOE's Hanford site, which is located near Richland, Washington. These tanks store more than 55 million gallons of highly radioactive wastes from nuclear weapons production. The law generally requires the Secretary of Energy, within specified times, to take the following steps to safely manage the high-level radioactive wastes stored in these tanks:

- Identify tanks with a "serious potential for release of high-level wastes."
- Develop tank safety action plans.
- Report to the Congress on tank safety actions.
- Prohibit the addition of high-level nuclear wastes to identified tanks.
- Continuously monitor identified tanks for excessive pressure and temperature.<sup>1</sup>

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<sup>1</sup>The amendment gave the Secretary 90 days from its enactment to identify tanks with a serious potential for release, 120 days to prepare action plans, and 6 months to submit a report to the Congress. Continuous monitoring of the identified tanks was to take place "as soon as practicable."

As agreed with your office, we were asked to (1) evaluate DOE's progress in meeting the law's requirements and (2) identify other conditions that could affect safe storage of the wastes at the tank facility.

While actions have been taken on all five of the law's provisions, some provisions have proven more challenging than others for DOE. DOE has prepared safety plans for problem tanks, reported to the Congress on its plans to improve tank safety, and set up procedures to ensure that no more high-level wastes will be added to problem tanks. However, identifying problem tanks and continuously monitoring them have proven to be more challenging and complicated tasks.

Other tank facility conditions also pose challenges to DOE's successful application of safety controls. During 1995, DOE reported 25 safety-related incidents in the conduct of tank facility operations. These incidents involved such matters as performing work without ensuring that required safety controls for potentially flammable gas are in place. DOE facility managers are aware of the operational problems and are concerned with this level of safety-related incidents. The managers have directed the Westinghouse Hanford Company—the tank facility contractor—to take steps to improve the conduct of operations at the facilities. Because DOE and Westinghouse are still putting these steps in place, it is too early to determine whether the problems will be successfully resolved.

#### WORK CONTINUES ON MEETING THE LAW'S REQUIREMENTS

DOE's efforts have resulted in safety plans for problem tanks. DOE has provided the Congress with its plans to improve tank safety, and it has set up procedures to ensure that no more high-level wastes will be added to problem tanks. However, DOE continues to work to identify which of the tanks have a serious potential for releasing of high-level wastes and to complete the network of instruments needed to continuously monitor the problem tanks.

#### DOE Prepared Generic Safety Plans, Reported to the Congress on Safety, and Prohibited Adding Wastes

DOE has prepared the required action plans for responding to excessive temperature or pressure or a release of high-level wastes from identified problem tanks. DOE identified and prepared general action plans for the

following four problem areas that could, if left uncontrolled, result in releases of high-level wastes.

- The generation of flammable gases through chemical reactions in the tanks.
- The presence of flammable organic chemicals.
- The presence of potentially explosive ferrocyanide compounds.
- High heat levels generated by certain types of wastes.

An example of DOE's action plans is the one prepared for tanks with potentially flammable organic chemicals. The plan describes when corrective actions should take place, the general corrective actions to be taken, and the designation of who would be responsible for the actions. Most action plans pertain to multiple tanks that have the same type of problem. Only two tanks have specific action plans of their own: The first is C-106, the single high-heat tank on the "watch list," and the other is SY-101, which has the highest level of flammable gas generation of any tank.

As required by law, DOE reported to the Congress on its actions to promote tank safety and the timetable for resolving outstanding issues on how to handle the wastes in problem tanks. DOE reported to the Congress on these matters on July 16, 1991.

The law generally prohibited the transfer of high-level wastes to tanks on the watch list. In response, DOE took the following three actions:

- DOE included, in its operating orders for tanks on the watch list, specific prohibitions from transferring additional high-level wastes to these tanks.
- DOE's operating procedures now call for all waste transfers to be planned in advance and for the plans to be written, reviewed, and approved before the transfer of wastes takes place.
- Finally, according to the Westinghouse official in charge of reviewing waste transfers and DOE officials, most of the transfer pipes of tanks on the watch list have been welded shut, physically isolating the tanks.<sup>2</sup> An approved

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<sup>2</sup>There are 48 single-shell waste tanks and 6 double-shell tanks on the watch list. All of the single-shell tanks are physically isolated. Because of the layout of the tank

"work package" is required to reconnect them, and no such approvals have been granted.

Additionally, the law provides for waste transfers to tanks on the watch list under certain limited circumstances if the Secretary of Energy determines that such transfers are necessary. According to DOE officials, no such determinations or transfers have been made.

### Identifying Problem Tanks Has Been an Evolving Process

In February 1991, when DOE responded to the law's requirement to identify which of the 177 tanks had a serious potential for releasing high-level wastes, it identified 53 such tanks. These tanks were placed on a watch list and were subject to safety controls aimed at preventing fires or explosions in the tank wastes. For example, work on tanks with flammable gas problems is to be performed with tools that will not cause sparks. According to DOE officials and contractor personnel, the information used to identify the 53 tanks was the best available data at the time. However, the data consisted of often incomplete historical records dating back to the mid-1940s, when the first groups of tanks were put in service.

As DOE became more knowledgeable about the tanks' contents, it changed which tanks were on this watch list. For example, 10 tanks were added in 1994 after more thorough DOE and contractor reviews of process production records and added waste sample tests indicated the presence of potentially flammable organic chemicals in the wastes. Six tanks were dropped during 1993-94 because they were misidentified as having ferrocyanide above the threshold amounts. As of March 1996, the watch list contained 54 tanks.<sup>3</sup> Table 1 shows, on a category-by-category basis, how the composition of the list has changed.

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facilities, the double-shell tanks are not isolated; instead, they are administratively controlled through the use of "locks and tags" on the valves.

<sup>3</sup>The latest published watch list was dated October 31, 1995; as of March 1996, DOE officials said that the list had remained unchanged.

Table 1: Comparison of Watch Lists--1991 and 1996

Month and year of list	Flammable gas generating tanks	Tanks with organic chemicals	Tanks with ferrocyanide compounds	Tanks with high-level heat	Total <sup>a</sup>
February 1991	23	8	24	1	53
March 1996	25	20	18	1	54

<sup>a</sup>The present list contains 54 tanks, but the numbers in the categories add to more than 54 because 10 tanks have problems in multiple categories. The original list had three tanks with multiple watch list problems.

Additional changes to the watch list may occur. For instance, DOE-Richland and Westinghouse have recommended to DOE headquarters that 25 tanks be added because of the potential presence of flammable gases. As of March 1996, DOE's investigation was not yet complete, and DOE had not decided whether to add the tanks or not. DOE-Richland also believes that 18 tanks identified as having ferrocyanide compounds can be removed from the list. DOE-Richland plans to demonstrate whether the tanks are safe enough to be removed from the list and to seek DOE headquarters' approval to remove them.

However, the idea of a watch list, with its imposition of safety controls on a smaller group of tanks, is also undergoing change. Because of increased concerns about the presence of flammable gases in all 177 storage tanks, DOE-Richland has placed flammable and organic chemical safety controls on all of the tanks. DOE and Westinghouse officials said that they did so as a worker safety measure after discovering pockets of flammable gases in tanks that were previously thought to have been clear of flammable gas problems. The imposition of these safety measures does not mean, however, that all 177 tanks were placed on the watch list. Instead, DOE has not yet decided if these restrictions are only a temporary measure or if they should be permanent. However, until DOE completes its assessment of cleanup safety, certain tank cleanup activities, such as saltwell pumping and rotary core mode drilling, are

suspended.<sup>4</sup> DOE plans to complete its safety assessment of these problems and develop any needed modifications by June 1996.

Continuous Monitoring for Temperature and Pressure Has Proven Challenging

The law called for DOE, "as soon as practicable," to place continuous temperature and pressure monitors on tanks identified as having a serious potential for releasing high-level wastes. In all cases, tanks on the watch list have been monitored in some form for temperature or pressure—but not necessarily on a continuous basis. As of March 1996, 47 out of 54 of the tanks on the watch list had continuous temperature monitoring.<sup>5</sup> DOE has plans to complete the installation of continuous temperature monitors on the seven watch-list tanks by September 1998. As of March 1996, 5 out of 54 tanks had continuous pressure monitors. DOE intends to install pressure monitors on the 21 flammable gas tanks on the watch list. But for technical reasons, DOE does not intend to install continuous pressure monitors on tanks with ferrocyanide or organic compounds in the wastes. DOE's plan is for the pressure monitors for flammable gas tanks on the watch list to be installed in an upgrading of the tanks' instrumentation, which will be completed by October 1996.

DOE intends the continuous pressure monitoring of the flammable gas tanks on the watch list to give information on the relationship between weather (barometric pressure) changes and the amount of flammable gases that remain in the wastes.<sup>6</sup> DOE does not intend the monitoring to be a warning device. The primary means of early warning of changes in the flammable gas tanks' status is through continuous temperature and flammable gas sampling (DOE is

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<sup>4</sup>Saltwell pumping is a process by which liquids are removed from single-shell tanks to double-shell tanks. This process is an interim stabilization step in the overall cleanup of the tanks. Rotary core mode drilling is a means of obtaining samples of the wastes in order to characterize the tanks' contents.

<sup>5</sup>The latest published data was dated October 31, 1995; as of March 1996, DOE officials said that the data have remained unchanged.

<sup>6</sup>DOE officials have identified what they believe is an indicator of the amount of flammable gases trapped in the wastes. The officials believe that changes in the amount of trapped gases and the level of wastes in the tanks are linked to the amount of atmospheric pressure. For example, lower atmospheric pressure means that it is easier for gases to escape from the wastes, and less trapped gases means that a tank's waste level goes down. The reverse is true if there is more pressure.

also installing monitors that detect the presence of flammable gases in the tanks).

DOE officials believe that continuously monitoring pressure is unnecessary for tanks with ferrocyanide or organic compounds in the wastes. The officials believe that continuous monitoring of pressure is an unneeded expense for tanks with ferrocyanide for two reasons. First, there is a low risk of a reaction causing a pressure buildup because "aging" has reduced the energy levels of ferrocyanide in the tanks, the wastes are too wet, and the temperatures are too low to start the reactions. Second, even if a reaction were to happen, the waste temperatures in the tanks would rise faster than the pressure would built up, and consequently, continuous temperature monitoring would provide a better early warning. All of the ferrocyanide tanks on the watch list have continuous temperature monitors. According to DOE program managers, there are similar reasons for not continuously monitoring the pressure of tanks with high levels of organic compounds. For those tanks that are not continuously monitored for pressure, DOE will continue to depend upon tank pressure measurements taken on a weekly or periodic basis. Since the law provides for instituting continuous monitoring "as soon as practicable," it appears that DOE has the discretion to decide, on the basis of the relevant facts and circumstances, when the institution of continuous pressure monitoring of specific tanks is reasonable or practicable.

According to an official in DOE's Tank Safety Issue Resolution Projects, the installation of continuous temperature and pressure monitors has taken more than 5 years for two reasons. First, the installation of continuous temperature and pressure monitors was part of a general upgrade of tank instrumentation and a move to computer monitoring of the instruments. Second, remediation of tank SY-101, the tank generating the highest amounts of flammable gases, took priority, and management's attention and funding were directed toward that effort.

#### OTHER SAFETY-RELATED PROBLEMS ALSO AFFECT SAFE STORAGE OF TANK WASTES

As you requested, we also looked for other conditions that could affect the safe storage of wastes in tanks with a potential for releases. Our review of DOE's records showed a number of recent problems with the day-to-day operations of the tank facilities, including the failure to apply controls to tanks on the watch list stemming from inadequate planning, poor communications, inadequate management, and worker's error.

Our review centered on the list of "off-normal and unusual events" maintained by DOE as a required part of its nuclear safety program.<sup>7</sup> For 1995, the list contained 121 such events. It should be noted that all of these events were identified by DOE's safety notification process and reported by the contractor's workers. We consider this very important for DOE's and Westinghouse's efforts to correct their problems, since without an honest reporting system, DOE would have little chance of improvement. DOE's records show 25 of the 121 as either being caused by human error or demonstrating a failure to follow safety procedures.<sup>8</sup> The 25 events occurred on watch list tanks, tanks under safety controls, tanks that potentially could have been on the watch list, and tanks that were not on the watch list at the time. However, the current extension of watch-list safety controls to all 177 tanks underscores the importance of safety procedures at all tanks.

Here are several examples of the kinds of safety problems identified. (See enc. II for a complete listing of all 25 events.)

- Delays in implementing safety controls. DOE requires that when the concentration of organic chemicals in wastes is greater than what the criteria allow, safety controls should be immediately established for the tank, and the tank should be considered for placement on the watch list. Samples taken from tanks C-201 and C-202 indicated levels of organics above the limits, which should have meant immediately placing the tanks under watch-list safety controls. Instead, controls were instituted on tank C-201 30 days after the initial laboratory notification and 55 days afterward for tank C-202. According to a DOE review, the causes of this incident were personnel error, as well as breakdowns in decision-making, operations, engineering, and other responsibilities.
- Overlooked safety procedures for preventing sparks. Personnel working on tanks with potentially flammable gases are to reduce the potential for sparks by grounding the various metal work surfaces. This process is called "bonding." In May 1995, workers sampling tank U-103, a flammable gas tank

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<sup>7</sup>DOE defines off-normal events as unplanned events that adversely affect or potentially affect the facility's safety or are an indication of a safety degradation. Unusual events are nonemergency events that have significant impact or potential for impact on safety. Unusual events are more severe than off-normal events.

<sup>8</sup>We excluded events with mechanical breakdown as a root cause or those contaminations of workers that seemed to be simply a result of working in a highly radioactive work environment.

on the watch list, failed to bond a sample holder as required by procedures. An error in reading the job plan led the supervisor to overlook the bonding requirement. DOE undertook corrective action to make work plans more "user friendly" and provide additional training for its field personnel.

- Work performed without flammable gas controls in place. Watch-list controls for flammable gas tanks were placed on two tanks (BY-103 and BY-106) in May 1995. The tanks were not yet on the watch list but were placed under watch-list controls because of an ongoing investigation of their potential danger. Despite the requirement for controls, from July 20 to July 25, 1995, work was performed on the tanks on three different occasions without the required flammable gas controls. In response to this occurrence, DOE will provide added training on the implementation of the appropriate controls.

Further examples of safety breakdowns include sampling the wrong tank, not locking out the proper electrical breakers before performing electrical work, and contaminating workers because safety procedures were not followed.

DOE's Manager of Tank Facility Operations is aware of these problems and in November 1995 asked the contractor to improve operations at the facility. DOE and Westinghouse are instituting a series of steps that they hope will address the problem. For instance, DOE is increasing its oversight in the field by adding five DOE facility representatives to the existing two now in place, an action to be completed by April 1997. Westinghouse has also directed its tank facility managers to increase their direct supervision of the work by spending 4 more hours weekly in the facilities. Additionally, the tank facility work processes are being reengineered. According to the DOE operations manager, the reengineering will include the following safety improvements: a simplification of the work processes, a reduction in the layers of management, and an increased use of work teams.

Since DOE's and Westinghouse's efforts are not yet complete, it is too early to determine whether the problems will be successfully resolved. However, we agree with DOE that effective actions to address these problems are necessary. Without them, there is less assurance that the safety-related requirements of the 1991 law will have their desired effect.

#### AGENCY COMMENTS

We provided DOE with a draft of this report for the agency's review and comment. We received comments from the Assistant Manager, Office of Tank Waste Remediation System, and from other officials from DOE-Richland and DOE headquarters. DOE agreed with the information presented in our report

and provided us with clarifications, which we have incorporated where appropriate.

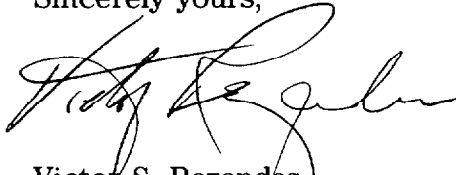
SCOPE AND METHODOLOGY

We conducted our review at DOE's Richland Operations Office in Richland, Washington. We reviewed DOE's compliance with the law's provisions and assessed the agency's response to them by interviewing DOE and contractor officials and reviewing agency plans and evaluations of tank facility operations. Our work was performed from October 1995 through March 1996 in accordance with generally accepted government auditing standards.

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As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send a copy to the Secretary of Energy. We will also make copies available to others upon request. If you have any questions concerning this report, please contact me at (202) 512-3841.

Sincerely yours,



Victor S. Rezendes  
Director, Energy, Resources,  
and Science Issues

Enclosures - 2

STATUS OF CONTINUOUS MONITORING OF WATCH-LIST TANKS  
AS OF MARCH 1996

Tanks on watch list	Reason on watch list				Continuous monitoring in place?	
	Flammable gases	Ferrocyanides	Organic chemicals	High heat	For temperature	For pressure
A-101	X		X		No	No
AN-103	X				Yes	Yes
AN-104	X				Yes	Yes
AN-105	X				Yes	Yes
AW-101	X				No	No
AX-101	X				No	No
AX-102			X		No	No
AX-103	X				No	No
B-103			X		No	No
BY-103		X			Yes	No
BY-104		X			Yes	No
BY-105		X			Yes	No
BY-106		X			Yes	No
BY-107		X			Yes	No
BY-108		X			Yes	No
BY-110		X			Yes	No
BY-111		X			Yes	No
BY-112		X			Yes	No
C-102			X		Yes	No
C-103			X		Yes	No
C-106				X	Yes	Yes
C-108		X			Yes	No

Tanks on watch list	Reason on watch list				Continuous monitoring in place?	
	Flammable gases	Ferrocyanides	Organic chemicals	High heat	For temperature	For pressure
C-109		X			Yes	No
C-111		X			Yes	No
C-112		X			Yes	No
S-102	X		X		Yes	No
S-111	X		X		Yes	No
S-112	X				Yes	No
SX-101	X				Yes	No
SX-102	X				Yes	No
SX-103	X		X		Yes	No
SX-104	X				Yes	No
SX-105	X				Yes	No
SX-106	X		X		Yes	No
SX-109	X				Yes	No
SY-101	X				Yes	Yes
SY-103	X				Yes	No
T-107		X			Yes	No
T-110	X				Yes	No
T-111			X		Yes	No
TX-105			X		No	No
TX-118		X	X		Yes	No
TY-101		X			Yes	No
TY-103		X			Yes	No
TY-104		X	X		Yes	No
U-103	X		X		Yes	No

Tanks on watch list	Reason on watch list				Continuous monitoring in place?	
	Flammable gases	Ferrocyanides	Organic chemicals	High heat	For temperature	For pressure
U-105	X		X		Yes	No
U-106			X		Yes	No
U-107	X		X		Yes	No
U-108	X				Yes	No
U-109	X				Yes	No
U-111			X		Yes	No
U-203			X		Yes	No
U-204			X		Yes	No
Total <sup>a</sup>	25	18	20	1	47 Yes, 7 No	49 No, 5 Yes

<sup>a</sup>The present watch list contains 54 tanks, but the numbers in the categories add to more than 54 because 10 tanks have multiple problems warranting listing.

SELECTED SAFETY INCIDENTS FROM 1995 TANK FACILITY OPERATIONS

We selected the following 25 from a list of 121 off-normal or unusual events reported by the Department of Energy (DOE) in 1995. The 25 events were either caused by human error or a demonstrated failure to follow safety procedures. The incident numbers shown are DOE's identification numbers.

Incident	Description	DOE's actions
Number 11	On January 24, the rotary mode core sampler truck was operating in the push mode (no drill rotation) on tank 242-BY-106 per the approved work plan. When obtaining the last few samples, the drill string was purposely "bumped" under direction of the engineer in an attempt to achieve better sample recovery. "Bumping" refers to short rotation of the drill string for several seconds without the nitrogen purge gas used during normal rotation. This incident's cause was personnel error, and it was a violation of the safety procedures.	DOE revised procedures. DOE conducted safety discussions with involved personnel.
Number 14	On January 30, the bottom detector for the push mode core sample truck was inoperable. The bottom detector is one of several methods designed to prevent drilling through the bottom of the tank or bending the drill string. Rather than stop to repair the bottom detector, the engineer modified the work plan to operate the sample truck without the bottom detector, thereby enabling sampling to continue. This incident's cause was a personnel error, and it was a violation of the safety procedures.	DOE sent appropriate engineering staff to the Conduct of Operations class and also conducted discussion with personnel on the safety and operating envelope of rotary sampling.
Number 16	On February 22, installation of a new tape and plummet (measuring device) had brought into question the current level in the primary tank. The Automatic Level Indicating Device showed 6.6 inches of waste. The new manual tape indicated the tank had a level of 4.25 inches. According to the operating requirements, the tank's waste level is to be maintained at or above 6 inches to prevent the uplift of the tank's bottom owing to an excessive vacuum. Recovery plans included pumping flush water into the tank until the level was greater than 7 inches in case the new tape was accurate. Subsequent in-tank videos showed that the new tape went slack at approximately 2.5 inches after the zero mark, which meant the level was above 6 inches despite what the new tape read. Further investigation revealed that the reference drawings and the Operational Test Report conducted after the construction of AP Tank Farm differed by 2.25 inches. This incident's cause was a design problem.	DOE is checking the other manual tapes in other farms.

Incident	Description	DOE's actions
Number 17	Valves are locked and tagged to protect workers from inadvertently opening valves that may be part of equipment being worked on. In this case, on February 23, the wrong valve was locked and tagged. The work was completed, and only afterward when a "tagout" was needed was the error discovered. This incident's cause was a personnel error, and it demonstrated inadequate technical review.	DOE is changing procedures to verify a safe condition before performing work.
Number 26	Only authorized personnel can open and close valves and only after approval. On March 13, a Kaiser worker, under direction from Westinghouse work team members, mistakenly closed a tank breather filter valve to perform an equipment installation. This valve is normally required to be left open; its closed condition was not conveyed to the shift manager as required by procedures. This incident's cause was a personnel error, and it was a violation of procedures.	Personnel were counseled on the "serious consequences of becoming complacent when doing repetitive tasks, and 'assuming' that certain steps are contained in a procedure." Additionally, a safety notice was sent to all personnel.
Number 27	Valves are locked and tagged to protect workers. In this case, a valve was "danger-tagged" for another job being performed in the area. The valve handle was also removed to prevent the valve from being used. A vapor-sampling crew started work on March 15 and a subcontracted technician disregarded the danger tag and used a crescent wrench to open the valve without authorization. The supervisor was not located where the work was going on, and the technician had not been through lock and tag training. This incident's cause was a personnel error and it was a violation of procedures.	DOE is requiring that a certified operator or supervisor be present in future operations and that training be provided. This incident was also discussed with all tank farm operations personnel.
Number 34	Valves are locked and tagged to protect workers. In this incident on March 30, a valve had two sets of locks and tags on it--one set placed by Kaiser workers and one by Westinghouse workers. The Westinghouse personnel cleared a "Danger Tag" on the valve, which still had a subcontractor's "Overtag" hanging on it. The organization that put the tag on the valve is supposed to remove it to provide assurance that the condition causing the lockout was cleared. This incident's cause was a personnel error, and it was a violation of procedures.	All tank farm personnel have been briefed on this incident, and lock and tag procedures have been revised.

Incident	Description	DOE's actions
Number 40	When preparing to sample vapors in tank TY-104 on April 12, the job supervisor discovered that a craftsman had installed a valve on one of the tank's risers prior to establishing electrical bonding, a requirement for ferrocyanide/organic watch-list tanks. This incident's cause was a personnel error, and it was a violation of procedures.	All field-sampling activities were suspended, pending a review of procedures and an evaluation of corrective actions for the five previous field-sampling events that have occurred since the beginning of calendar year 1995.
Number 42	The levels of wastes in the single-shell tanks are monitored to identify if tanks are leaking or if other conditions within the tanks are changing. Operational specifications for tank S-108 require a weekly level reading. The level was measured on April 22 and 24, but transmission of the level for electronic storage failed, and a subsequent reading and transmission also failed. Both failures went undetected until a later review identified the condition. Normally, failures to transmit are reported by the data van operators, but these readings were taken on the weekend, and the personnel who usually inform Operations were not at work. The second attempt's failure was the result of personnel's unfamiliarity with the data van's layout. This incident's cause was a personnel error, and it was a violation of procedures.	Involved personnel were counseled, and procedures for validating data transfers on weekends are to be improved.
Number 45	Many areas within the tank facilities are seriously contaminated with radioactivity, and personnel working in the areas are required to wear protective clothing. Furthermore, to prevent the spread of the surface contamination, workers' access to the areas is controlled. Through a series of mistakes on May 2, a subcontractor employee, who should have been in radiation protection clothing and escorted because of his lack of training, gained unescorted, unprotected access to contaminated areas of the West Tank Farm. He entered, left, and reentered the area, crossing multiple radioactivity warning barriers. His actions raised the possibility of spreading contamination. Subsequent checks showed no contamination to the individual or the area. This incident's cause was a personnel error, and it was a violation of procedures.	The employee's privileges to access controlled areas were terminated.

Incident	Description	DOE's actions
Number 49	Protection against sparks is required for operations on tanks with flammable gases to prevent possible ignition. The grounding of metal surfaces is called "bonding." After the work was completed on tank U-103 on May 24, it was found that the sample holder used during supernate sampling was not bonded as required by "watch list" work conditions. This incident's cause was a personnel error, and it was a violation of procedures.	All work activities were suspended for one-half day to review this occurrence with all field personnel. Sampling procedures are being revised to make them more user-friendly. Other actions have been taken or are under way.
Number 58	For work being performed in the tank farms, the Shift Operations Manager must approve, or "release" work before it can be started. Lock and tagged work must be cleared before work can start for the protection of the workers. Work on the 242A exhaust fan was started on June 1 without the notification of the Shift Operations Manager and without proper authorization. Furthermore, the work started before independent verification of the lock and tag removal. This incident's cause was a personnel error, and it was a violation of procedures.	Work was immediately stopped; all personnel were counseled.
Number 61	Tanks are placed on the watch list or under watch-list controls when evidence shows that the tank wastes exceed previously established thresholds. For example, if the total organic carbon constitutes more than 3 percent of a tank's wastes by weight safety, controls would be established over the tank, and the tank would be considered for placement on the watch list. Samples taken from tanks C-201 and C-202 indicated levels of organics above the limits, which should have meant immediately placing watch list conditions on the tanks. Instead, controls were placed on tank C-201 30 days after the initial laboratory notification and 55 days afterward for tank C-202. This incident was discovered on July 21; and its cause was a personnel error, as well as "breakdowns" in decision-making, operations, engineering, and responsibilities.	Westinghouse's assessment team recommended that nine different actions be undertaken. The actions ranged from improving and promulgating "roles and responsibilities" to consolidating watch-list administrative controls to reduce current redundancies.
Number 63	Watch-list controls are placed on the tanks to ensure the safety of workers and the environment. Tanks BY-103 and BY-106 had watch-list controls for flammable gases placed on them while they were being investigated for possible placement on the list. Despite requirements, watch list controls on these tanks were not included in work packages. Consequently, three work actions were performed over a 6-day period on these tanks without "sparkless" tools. This incident was reported on July 25. Its cause was a personnel error, and it was a violation of procedures.	Training will be provided on the appropriate controls and their implementation.

Incident	Description	DOE's actions
Number 65	Workers' exposure to radiation is limited for health reasons. The administrative level set for a worker's exposure is 500 millirems (a measure of radioactive exposure). An operator working on tank BY-105 on July 28 had accumulated approximately 410 millirems. He was allowed to continue work after being given additional personal radiation-monitoring devices. He kept close watch on his radiation monitors while working and left when he believed he approached the limit. Since he was so close to the administrative limit, he was not allowed back to work until his record dosimeter was read (a more accurate measurer of actual exposure than the other devices he was also issued). The results showed he had received 538 millirems of exposure. This incident occurred because of inadequate planning and reliance upon measurement systems that provide estimates rather than the actual cumulative dose. This incident's cause was a management problem of inadequate controls and poor work processes.	While DOE has not instituted all the corrective actions, it has started to review the total exposure needs for operators and to determine appropriate administrative control levels.
Number 70	Work on the tanks is planned for specific tanks and for specific tasks. A crew was sent into the tank farm to sample vapor in tank B-112 on August 29 but was misdirected by the supervisor to tank B-110; the supervisor was not at the work site but was 50 feet away. The crew sampled tank B-110. According to DOE, the consequences of this event could have been more serious had the mistaken tank been on the watch list and the proper controls not been in force. This incident's cause was a personnel error.	The planned corrective actions include counseling supervisors on their responsibilities to hold pre-job briefings to clarify the objectives of the work and improving how the tanks are identified.
Number 72	Procedures require an exhauster to be running while wastes are pumped from one tank to another to prevent the buildup of heat. In this incident on August 31, "saltwell" pumps were pumping wastes from tanks BY-103, BY-106, and BY-109 into the 244-BX double-contained receiver tank. For 4-1/2 hours, the exhauster was shut down while pumping went on. The Computer Automated Surveillance System operator failed to notice the alarm until 4-1/2 hours after it went off. The operator had several alarms during a short period of time, and all were reported except this one. The saltwell pump operator also did not notice that the exhauster was shut down. This incident was caused by a personnel error, and it represented a violation of procedures.	The planned corrective actions include revising the procedures to require 2-hour checks to verify that the exhauster is operating, reducing the number of alarms to only those needed, and correcting defective alarms.

Incident	Description	DOE's actions
Number 81	<p>Procedures require radiation exposure to be kept "as low as reasonably achievable." Properly shielding workers from radioactive materials is one of the basic practices to reduce exposure and to implement this requirement. In this incident on October 4, workers were pressure testing a transfer line. A leak was detected, and the workers, without protective gear, attempted to replace a gasket to stop the leak. In the process of repairing the line, 2 gallons of water leaked on to the floor and on the workers' hands and gloves. About 2 hours later, after leaving the work site and going to lunch, the workers found they were contaminated. The water in the lines was radioactive. This incident's cause was both a personnel error and a procedural problem.</p>	<p>DOE's planned corrective actions include revising pressure-testing procedures and designing and manufacturing a safer test assembly. Additionally, the workers were counseled on the importance of using personal protection equipment when doing work on potentially contaminated systems.</p>
Number 82	<p>In this incident, workers shut down power to equipment in the West Tank Farm to do planned maintenance on October 3. However, since the main exhaustor that provided ventilation was out of service, ventilation was provided by a backup system. When the workers shut down power, they found that the power supply that they cut also powered the backup ventilation system, leaving the tank farms with no active ventilation. Since the workers were unable to immediately restart the backup, several contamination alarms were not operating. The area was checked as a precautionary measure, and no contamination was found. The incident's cause was inattention to detail and poor shift communications.</p>	<p>The immediate actions taken included restarting the backup system and checking for contamination. This event was also discussed with all operations personnel.</p>
Number 83	<p>Locks and tags are used to protect workers' safety. In this incident on October 4, electrical work was to start at the 242-S facility. Workers were instructed to shut down power and lock and tag the main power feed breaker. The lock and tag were to be put on the breaker in cubicle "1C"; however, workers thought they were to lock out the breaker in cubicle "C1," located in the same area. Because of the confusion, workers thought the written instructions were incorrect and called the supervisor, who directed them to change the written instructions to lock and tag "C1." They locked and tagged the wrong breaker. Work was to begin on the next shift, when a new crew's work supervisor noticed that the wrong breaker had been locked and tagged. This incident's cause reflected personnel error, and procedures were not followed.</p>	<p>To strengthen the tank farms lock and tag program, a revised standing order for the program was issued on October 26, 1995. The order establishes requirements for providing more complete descriptions of equipment to tagged, management's attendance when hanging tags, and other procedural changes.</p>

Incident	Description	DOE's actions
Number 86	DOE and the contractor agree through the use of a written plan of operations, called the safety basis, on how the facility will be operated safely. Failure to maintain operations in line with the safety basis can lead to operations that are unsafe. Westinghouse did not change the Interim Safety Basis to reflect the correct identification of the facility's criticality specifications prior to implementing them. The Justification for Continued Operations was still identified in the safety basis as the facility's authorization basis when, in fact, the facility was using the recently revised criticality specifications. This incident was reported on October 5.	DOE has requested that Westinghouse continue operating under the more conservative, earlier criticality specifications until Westinghouse and DOE-Richland can conduct a review of the current authorization basis.
Number 91	Since most of the tank farm is underground, workers must depend upon plans for the layout of lines used to transfer wastes. Because of a conflict between two sets of plans, on October 19 the wrong line was pressure tested--SN-245 instead of SN-246. Before filling the line, the supervisor noted a discrepancy between the transfer line's configuration shown on the facility-controlled routing board and the controlled drawing. The supervisor, on the basis of previous experience, believed the routing board showed the correct configuration. As a result, an engineering change notice was ordered to correct the drawing, and the line fill proceeded to verify the configuration. After the test was conducted, DOE confirmed that the controlled drawing was correct rather than the controlled routing board.	The line fill was immediately halted, and planned changes to the controlled drawing were canceled. A second line fill was performed to confirm the current configuration of the system and to ensure that the routing board and drawing both reflected field conditions.
Number 94	Identifying tanks with potentially flammable gases has depended upon measuring the concentration of flammable gases in the space above the wastes in the tanks. Tanks that have concentrations of flammable gases above 25 percent of the lower explosive limit are put under safety controls, and if the readings persist, they are placed on the watch list. On October 24, workers were rotary core sampling tank BY-110, which was not a flammable gas watch-list tank. The drill string had been left in the wastes for 5 hours prior to its planned removal. Before removing the rotary core drill string, workers tested for the presence of flammable gases in the drill string, as required by safety procedures. The workers found flammable gases at 300 percent of the lower explosive limit in the drill string, while the space above the wastes had concentrations of only 1 percent of the lower explosive limit. DOE believes the drill string hit a pocket of flammable gases. Finding potentially flammable gas mixtures in a tank that is not on the watch list raises questions about the criteria for identifying tanks with flammable gas problems.	DOE subsequently put all 177 tanks under flammable gas watch-list controls.

Incident	Description	DOE's actions
Number 99	Sparkless tools and equipment are necessary for work conducted on or around tanks under flammable gas watch-list controls to prevent ignition of the gases. In a review conducted to assess the feasibility of operating the rotary core drill in a flammable gas environment, an outside expert discovered on November 7 that the sampling trucks had equipment that may not have met National Fire Protection codes for electrical equipment working in a potentially flammable environment. The subsequent investigation showed that the design of all four of the sampling trucks did not meet the fire code. When the trucks were being designed, DOE did not believe that finding high concentrations of flammable gases in the drill string (see incident 94) was possible. Therefore, the more stringent fire code standards were not used. According to DOE, the root cause of the incident was inadequate design.	DOE suspended all rotary and push mode core sampling in flammable gas watch-list tanks. Additionally, DOE has set up interim measures to be in place until the truck equipment is evaluated for its possible redesign.
Number 112	Work procedures for watch-list tanks include a provision that an air sample be collected prior to replacing filters. On December 6, 1995, work had started on replacing the prefilters in the AN Tank Farm, when the industrial hygienist, who was responsible for taking the air sample, arrived at the work site. The supervisor immediately realized that the required air sample had not been taken. The problem arose because work instructions had been rewritten to make them more user-friendly. This older work package had not been updated, and the requirements, which were placed in an unfamiliar part of the package, were overlooked. According to DOE, several times during the review, approval, and work release process, there were opportunities to note that the proper operating reviews were incomplete and that prerequisite signatures were not obtained. DOE attributed the cause of this event to inadequate procedures and personnel's inattention to detail.	DOE will include notices in the work packages to alert the work reviewers that the activity will be taking place on a watch-list tank and will require a more thorough review of the required signatures. Also, the critique of this event will be issued as required reading to reinforce the need for developing and using proper and correct procedures.

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